Simulators for Safer Shipping

Aerospace-derived research and training aids for reducing maritime accidents highlight spinoffs in the field of transportation

Through the windows of the CAORF bridge, deck officers see a simulated harbor exactly as it would appear on a real approach. Computer-directed equipment (shown above the bridge) projects a visual image on a panoramic screen, and for extra realism harbor sounds are also duplicated.

Each year one ship out of every five afloat collides with another vessel, or rams a dock, or runs aground. Such accidents cost multimillions annually, but the monetary loss is the lesser part of the problem. Of greater concern is the incalculable cost in human lives, injuries sustained and environmental damage.

The marine safety problem is compounded by the fact that merchant ships are getting bigger and faster, therefore harder to handle. Additionally, maritime traffic density is increasing. When a supersize ship with inherently difficult handling qualities approaches a crowded, marginal harbor designed for the smaller ships of an earlier era, there is high potential for accident.

The situation, says the U.S. Maritime Administration (MarAd) of the Department of Commerce, is one of "increasing seriousness." MarAd is doing something about it. In addition to its general work to improve merchant shipping safety and productivity, MarAd has established a special program to reduce the number of ship accidents by learning more about how they are caused—and aerospace technology is playing a part in the effort.

Located on the grounds of the U.S. Merchant Marine Academy, Kings Point, New York, MarAd's National Maritime Research Center is seeking answers to the problem through operation of a highly sophisticated ship maneuvering simulator. Called CAORF —an acronym for Computer Aided Operations Research Facility—the simulator was designed and built by the Sperry Division of Sperry Corporation, Great Neck, New York. CAORF incorporates technology developed in a wide variety of aerospace simulation and technical training programs for the military services and NASA. Management and operational services for CAORF are provided by Grumman Data Systems Corporation, a subsidiary of Grumman Corporation, Bethpage, New York. Grumman built the Apollo Lunar Module for NASA, and the company has applied some of the expertise acquired in that program to its CAORF work.

CAORF can be set up to duplicate the exact handling qualities of any vessel, under various conditions of wind, tide and current; currently, a dozen different ships can be "plugged in." Bridge instrumentation is typical of modern shipboard equipment, in-

What appears to be a ship's wheelhouse is actually the bridge of a highly realistic simulator operated by the U.S. Maritime Administration in a research program aimed at reducing ship accidents. Based in part on aerospace simulation technology, the simulator is called CAORF for Computer Aided Operations Research Facility.

cluding radar, internal and external communications, and new collision avoidance systems. The make-believe ship—called "Ownship"—is manned on test runs by experienced masters, pilots and deck officers drawn from the merchant fleet.

Simulation focuses on harbors and restricted waterways within or just beyond sight of land, where sea lanes merge, traffic increases and human performance is most critical. Computerized equipment can simulate the sights and sounds of any harbor approach—in daytime, nighttime, fog or haze—as viewed through the bridge windows. Portrayed in full color on a 125-foot panoramic screen are other ships, shorelines, navigational aids, docking areas, bridges, buildings—everything the bridge crew would see if they were actually approaching the harbor simulated. Six moving ships can be shown simultaneously and the scene changes in response to the movements of "Ownship." In addition, the radar screen can project up to 40 ships that are simulated to be over the horizon and out of sight.

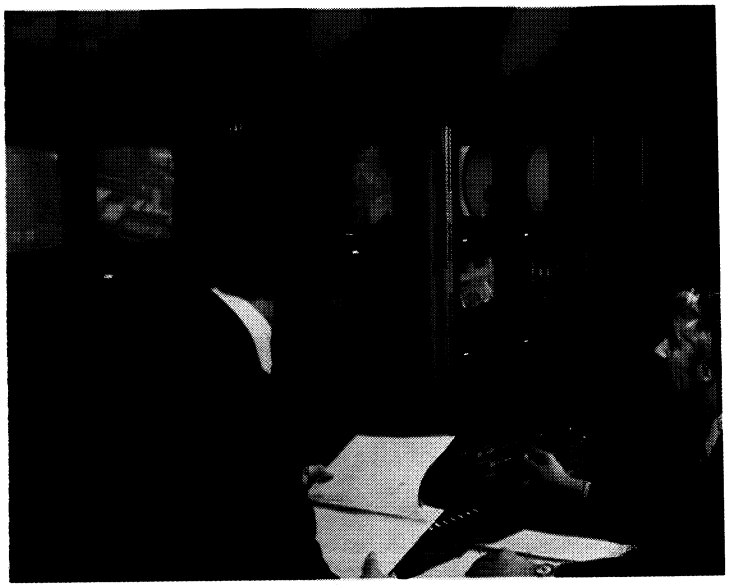
MarAd's research emphasizes the human element. CAORF includes a Human Factors Monitoring Station where a skilled psychologist assesses, via closed circuit TV, the behavior of watch officers in terms of work load, decision-making and reaction to hazard. A controller can induce ship malfunctions or precipitate collision danger to measure human performance in an emergency. MarAd explains the aim of this part of the research:

"Human error has been labeled the cause of 80 percent of maritime accidents. Yet it may well be that the fault lies somewhere else—with the need for operational procedures more in keeping with the real world, perhaps, or better equipment and information displays, or more efficient bridge designs."

From repetitive operation of the simulated ships, MarAd is building a valuable data base for improving marine safety. In addition to provisions for better human performance, the data can be applied to developing better vessel controllability in shallow waters, modifying restricted waterways for safer navigation, and determining harbor and terminal design criteria for large ships.

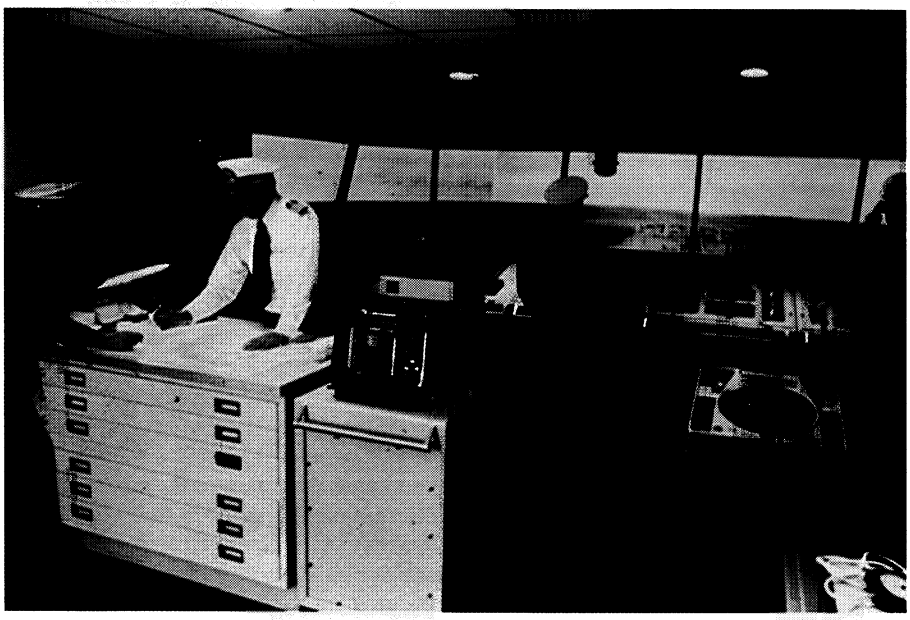
Sperry employed the same technology in development of another simulator, different in that it is designed for training bridge crews where CAORF is used for research purposes. Known as the Sperry Shiphandling Simulator, the system was built for Marine Safety International, Inc. (MSI), located at New York's LaGuardia Airport. MSI uses it to provide deck officer training for a number of ship-operating companies. The Shiphandling Simulator's exceptional realism, similar to that of CAORF, gives bridge crews hands-on experience under severe operating conditions without the risks associated with maneuvering real ships in critical situations.

This is a view from the wheelhouse as a simulated tanker—"Ownship"—approaches New York's Verrazano Bridge. The scene changes in response to movements of Ownship. Realism is further heightened by the fact that the other ships in the image also move, at the same relative speed as they would in a real-life situation. Analysis of ship collisions—and how they may be prevented—is a major part of the CAORF research program.



At CAORF's Human Factors Station, a psychologist monitors, via closed circuit television, the performance of the bridge crew and their reactions to simulated emergencies. Human error is considered the cause of most marine accidents, but the Maritime Administration is studying the extent to which other factors—such as operational procedures, information displays or bridge designs—may contribute.

CAORF exercises are managed from a console in the facility's control center. The research coordinator directs the simulated vessels involved in the test scenario, sometimes inducing malfunctions or precipitating collision courses as part of the experiment.



A companion system to CAORF is the Sperry Shiphandling Simulator, similar in operation and capability but designed for training where CAORF is used as a research tool. Located at New York's LaGuardia Airport, the Shiphandling Simulator is operated by Marine Safety International, Inc., a commercial firm which trains deck officers for shipping companies.

At Marine Safety International, a simulation engineer studies a model board of the harbor at Milford Haven, Wales. Scale models like this, painstakingly constructed to duplicate every detail of the real harbor, provide the basis for computerized projection of a life-size image on a screen forward of the Shiphandling Simulator's bridge.